2.2 Scintillator Detector Fabrication

2.2.1 Scintillator Strips

2.2.1.1 EDIA
2.2.1.2 Scintillator strip extruding
2.2.1.2.1 UMN - Build shipping apparatus
2.2.1.2.2 UC London - Purchase Near strips
2.2.1.2.3 FNAL - Fluor processing equipment, Extrusions, Dopants, QC Tech, Shipping, Miscellaneous

2.2.2 Fiber

2.2.2.1 EDIA
2.2.2.1.1 UC London - Clear Fiber, Ribbon Cable Test Machine, Near Detector Light Balancing Design
2.2.2.1.2 Indiana - Ribbon cable, Ribbon cable routing, Ribbon Cable Admin & Inspection, Ribbon Cable Test Machine
2.2.2.1.3 UMN - WLS Fiber evaluation (pre-production)
2.2.2.1.5 FNAL - WLS Fiber evaluation (pre-production), Near Detector Light Balancing Design, Fiber Purchase
2.2.2.1.6 Caltech - WLS Admin & inspection, WLS Fiber evaluation (pre-production)

2.2.2.2 Fiber M&S
2.2.2.2.1 Caltech - Purchase WLS Fiber for Startup, SM1-18, SM2, Shipping for WLS Fibers
2.2.2.2.2 Tex A&M - Fabricate 40% of Ribbon Cable for SM1 & SM2
2.2.2.2.3 UC London - Purchase Near Detector WLS Fiber, MUX Box Clear Fiber, Optical Ribbon Cable; Fabricate & Ship Ribbon Cable
2.2.2.2.4 Indiana – Purchase MUX Box Clear Fiber for SM1 & SM2, Purchase Optical Ribbon Cable for SM1 & SM2; Connector Glue; Shipping for Raw Clear Fiber & Clear Fiber Cable Assembly; Fabricate Ribbon Cable for SM1 & SM2; Set up Ribbon Cable Factory
2.2.2.2.5 James Madison - Fabricate 20% of Ribbon Cable for SM1 & SM2

2.2.3 Scintillator Modules

2.2.3.1 EDIA
2.2.3.1.1 UMN - Module Design & Prototyping; Testing & Administration for the following components: Optical Glue, Reflective Groove Seal, Light Case, End Manifolds, Light Injection Manifold, Structural Epoxy, Light Seals, Bypass parts, Module Mounting Hardware
2.2.3.1.2 ANL - Module Design & Prototyping for the following components: WLS Optical Glue Selection & Study, Reflective groove seal, Structural Epoxy, 4 Plane Prototype
2.2.3.1.3 FNAL - Module Design & Prototyping for the 4 Plane Prototype, and all Near Module Design
2.2.3.1.4 Indiana - Design & Prototyping of the Optical connector potting glue
2.2.3.1.5 Caltech - Module Design & Prototyping of the 4 Plane Prototype, and of Module mounting hardware
2.2.3.1.6 Tufts - Design & Prototyping of the 4 Plane Prototype, and of End manifolds

2.2.3.2 Near Detector Scintillator Module Parts – all done by UMN
Purchase all componets: Optical Glue, Resin & Hardener, Reflective Groove Seal, Light Case, End Manifolds (all parts), Light Injection Manifold, structural epoxy, end manifold RTV, optical connector potting epoxy, barcode labels, bypass, all module mounting hardware

2.2.3.3 Far Detector Scintillator Module Parts
2.2.3.3.1 UMN - Module Parts for part of SM1, and for SM2

2.2.3.3.2 Tufts - Module Parts for part of SM1
2.2.3.4 Near Module Parts produced by FNAL - Module End Manifolds

2.2.4 Photodetector Systems

2.2.4.1 EDIA
2.2.4.1.2 Texas @ Austin – Design & fabricate M16 PMT test stand, Design PMT voltage divider board, Build PMT base test stand, Purchase PMTs for evaluation, Labor for PMT qualification
2.2.4.1.3 UC London - Design & fabricate M64 PMT test stand, Purchase PMTs for evaluation, Labor for PMT qualification
2.2.4.1.4 Athens - Fabricate additional PMT test stands

2.2.4.2 Photodetectors
2.2.4.2.1 Texas @ Austin – Purchase, Test and Ship PMTs : SM1-218, SM1-24, SM2, and spares
2.2.4.2.2 UC London - Purchase, Test and Ship PMTs for the near detector
2.2.4.2.3 ATHENS - Test and Ship PMTs : SM1-218, SM1-24, SM2, spares

2.2.4.3 PMT Bases and Mounting
2.2.4.3.1 Texas @ Austin – all Bases and Mounting for SM1 & SM2, including the Electronics Connector Board, SHV Connector Board, Testing & Shipping
2.2.4.3.2 UC London - all Bases and Mounting for Near Detector, including the light-tight box, D connectors, Testing & Shipping

2.2.5 Mux boxes and Connector

2.2.5.1 EDIA
2.2.5.1.1 UC London – Alner Box design, administration and inspection
2.2.5.1.2 Indiana – MUX Box connector design, prototyping, & production administration, MUX box design, prototyping, & production administration
2.2.5.1.3 UNIV - MUX box design & prototyping
2.2.5.1.4 FNAL - Connector design & prototyping, Connector Mold & Tooling
2.2.5.1.5 Indiana - Purchase & Assemble Quality Control LED computer system

2.2.5.2 Connectors
2.2.5.2.1 Indiana – Purchase & Ship Connectors for SM1 & SM2, including the light-tight Connector Interface
2.2.5.2.2 UC London - Purchase Connectors for Near Detector
2.2.5.2.3 FNAL - Connector Metrology

2.2.5.3 MUX Box
2.2.5.3.1 Indiana – Purchase all MUX Box components for the Far Detector, including Stamped Boxes with RF Shield, Box Hardware, Gaskets, RTV sealant, Optical glue; purchase and ship all Box Rack Mounting Hardware; MUX Box Factory Setup; Assemble, Ship & Install MUX Boxes
2.2.5.3.2 Tufts - MUX Box Factory Setup; Assemble, Ship & Install MUX Boxes
2.2.5.3.3 UC London – purchase & assemble QC LED computer system for Near and Far detectors; Purchase all componets for Near Detector Alner boxes including : stamped box components, connectors, LED/diffuser, Hardware, Gaskets, RTV sealant, Optical glue, Cookies, Cookie holders, PMT holders, PMT jacket, PMT-Cookie Assembly Hardware, Magnetic Shields. Assemble boxes & Ship to FNAL
2.2.5.3.4 Texas @ Austin – Purchase Far MUX Box Components, including Cookies, Cookie Holders, PMT Holders, PMT Jackets

2.2.6 Calibration Systems

2.2.6.1 EDIA
2.2.6.1.1 FNAL - R&D and design work on light injection system

2.2.6.1.2 UC London – Light injection system for 4 Plane Prototype, Light Injection system R&D and Design, Design calibration module

2.2.6.2 Far Detector Light injection system

2.2.6.2.1 UNIV - Labor for system integration

2.2.6.2.2 UC London – purchase components and assemble LED Pulsers & fanout boxes; purchase and assemble light injection fiber cable & connectors; Install LED system on SM1 & SM2

2.2.6.3 Near Detector Light injection system

2.2.6.3.1 FNAL - Labor for system integration

2.2.6.3.2 UC London - purchase components and assemble LED Pulsers & fanout boxes; purchase and assemble light injection fiber cable & connectors; Install LED system on Near detector

2.2.6.4 Radioactive wire sources and driver

2.2.6.5 Calibration Module

2.2.6.5.1 Labor

2.2.6.5.2 Materials

2.2.7 **Factory Assembly & Testing Equipment**

2.2.7.1 EDIA

2.2.7.1.1 ANL - Design extrusion trimming machine, WLS fiber gluing machine; Specify assembly line computer; Design Factory equipment : Module Assembly Tables, Glue mixing machines, optical connector polishing jigs, Curing racks, Module storing racks, Module mapper

2.2.7.1.2 FNAL - Design Scintillator QC machine; Specify barcode tracking system, Design Light Case Forming Machine

2.2.7.1.3 UMN - Design Fiber QC machine, Design light case rolling/crimping machine

2.2.7.2 Equipment Purchase & Fabrication

2.2.7.2.1 Equipment for Prototype Factory

2.2.7.2.1.1 ANL - Module assembly trays, Factory DAQ, assembly line computer, WLS fiber gluing machine; Build & Operate Equipment for April'00 Factory; Configure Equipment for Near Module Production

2.2.7.2.1.2 UMN - light case rolling machines, Module crimping machine, WLS fiber gluing machine, WLS fiber Quality control monitor

2.2.7.2.1.3 FNAL - Light Case Machine, WLS fiber gluing machine, purchase & fabricate UV Extrusion QC Monitor

2.2.7.2.2 Equipment for Factory 1

2.2.7.2.2.1 ANL - Module assembly trays, Ass'y table gluing dispenser, curing racks, WLS Fiber Gluing Machine, Module Mapper including DAQ

2.2.7.2.2.2 Caltech - Extrusion trimming machines, Optical connector polishing machine, Assembly Tables, Detail Station Table, Mapper Table, Assembly Trays, Misc Equipment

2.2.7.2.2.3 FNAL - barcode system

2.2.7.2.2.4 UMN - WLS Fiber Gluing Machine, WLS fiber QC monitor, Crimper

2.2.7.2.3 Equipment for Factory 2

2.2.7.2.3.1 ANL - Module assembly trays, Module assembly tables, gluing dispenser, Optical connector polishing machine, curing racks, Lifting fixture, WLS Fiber Gluing Machine, Module Mapper including DAQ

2.2.7.2.3.2 FNAL - barcode system

2.2.7.2.3.3 UMN - Extrusion trimming machines, WLS Fiber Gluing Machine, WLS fiber QC monitor, Module Mapper, Module Storage Racks, Shuttle Tables & Assy Trays, Crimper

2.2.7.2.4 Equipment for Soudan

2.2.7.2.4.1 ANL - Module Mapper including DAQ

2.2.7.2.4.2 FNAL - barcode system

2.2.7.2.4.3 UMN - Module Mapper assembly line computer

2.2.7.2.5 Equipment for Near Detector Site
2.2.7.2.5.1 FNAL - barcode system, assembly line computer

2.2.7.2.5.2 UNIV - ribbon cable tester
2.2.7.2.6 Other Equipment
2.2.7.2.6.1 ANL - Optical Connector Polishing Machine parts
2.2.7.2.6.2 UC London - Optical Connector Polishing Machine, assembly line computer
2.2.7.2.6.3 UNIV - Ribbon Cable Tester

2.2.8 Factory Operation

2.2.8.1 EDIA & Outfitting Support – Argonne, including factory layout, Shipping crate design, Installation of Machines at Caltech & UMN,
2.2.8.2 Assembly line outfitting 1 - Caltech
includes acquiring the factory location, Building cleanup, Install utilities, Initial setup and prototyping, ship machinery to factory site, Install auxiliary equipment, Machine evaluation and start up, Training, Build shipping crates
2.2.8.3 Assembly line outfitting 2 - UMN
includes acquiring the factory location, Building cleanup, Install utilities, Initial setup and prototyping, ship machinery to factory site, Install auxiliary equipment, Install ventilation system, Machine evaluation and start up, Training, Build shipping crates
2.2.8.4 Module production
2.2.8.4.1 Caltech – Produce & Transport: 4 Planes of SM1 startup modules, 60 Calibration modules, 117 SM1 Planes, 130 SM2 Planes
2.2.8.4.2 UMN - Produce & Transport: 121 SM1 Planes, 112 SM2 Planes
2.2.8.4.3 ANL - Produce & Transport all Near Detector Modules

2.2.9 Scintillator Management

2.2.9.1 Salaries for assembly & factory managers at ANL & UMN
2.2.9.2 Travel for assembly, factory, and L2 managers